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AUTHOR Small, Ruth V.; Samijo
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ABSTRACT

Research on the motivational aspects of multimedia games may provide ways to design more engaging user information systems which increase users' exploratory and information-seeking behaviors. Two small-scale exploratory studies examined the effects of introducing information on the intrinsic motivation of users of a CD-ROM game. Results of the first study showed a negative relationship between age and both trait and state curiosity, and a negative relationship between tolerance for ambiguity and state curiosity. The first study showed a significant decrease in state curiosity after subjects received informational clues while the second study found that subjects who received informational help sheets had significantly greater curiosity. (Contains 44 references.) (Author)

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How Information Affects Intrinsic Motivation: Two Exploratory Pilot Studies

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Ruth V. Small
Syracuse University

Samijo
Syracuse University

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Abstract

Research on the motivational aspects of multimedia games may provide ways to design more engaging user information systems which increase users' esploratory and information-seeking behaviors. Two small-scale exploratory studies examined the effects of introducing information on the intrinsic motivation of users of a CD-ROM game. Results of Study I showed a negative relationship between age and both trait and state curiosity, a negative relationship between tolerance for ambiguity and state curiosity. Study I showed a significant decrease in state curiosity after subjects received informational clues while Study II found that subjects who received informational help sheets had significantly greater curiosity.

Introduction

Researchers of information systems often focus on the user performance (e.g. learning) during a human-computer interaction and ignore motivational factors that affect that experience. Research on computer learning games has revealed that they are most powerful for generating and enhancing interest and motivation (e.g. Chartier,1973; Cherryholmes, 1966; Klein and Freitag, 1991; Malone, 1981).

Investigations which look at various motivational variables of users while using computer games may provide insight into (1) designing more engaging user interfaces, (2) increasing users' intrinsic motivation and feelings of competence, and (3) stimulating better and greater use of other types of information systems (Trevino & Webster, 1992; Webster, Trevino, & Ryan, 1993).

This research explored the relationships of several motivational variables and the introduction of information during an ambiguous but highly engaging task. Two pilot studies explored curiosity and flow as indicators of intrinsic motivation for users of the multimedia CD-ROM game *Myst* (Broderbund Software, Inc. and Cyan, Inc., 1994).

Intrinsic Motivation

Deci (1975) describes intrinsic motivation as an innate need, founded on competence and self-determination, to explore one's environment. Intrinsically motivating activities are those that stimulate play, exploration and the development of cognitive structures through challenge and incongruity (Deci, 1975). Malone (1981) describes an intrinsically motivating activity as one in which people engage in it for its own sake, rather than for some external reward. Intrinsic motivation may be demonstrated by a demonstrated by a range of motivational factors. This research focused on two seemingly-related factors---curiosity and flow---of subjects engaged in an ambiguous task.

Curiosity

Berlyne (1960) describes "curiosity" as exploratory behavior in search of an optimal state of arousal and epistemic curiosity as an internalized search to resolve some conceptual conflict and achieve knowledge. Day (1982) differentiates between trait curiosity, a general propensity for being curious, and state curiosity, a demonstration of curious behavior toward a specific thing, task. event, or situation.

Boykin and Harackiewicz (1981) found a positive correlation between curiosity and uncertainty. Ingwersen (1992) defines uncertainty as "a state of doubt in which the individual's own state of knowledge, work space and cognition cannot fill the problem space by thinking, causing interaction with the world around it to obtain supplementary information" (p. 131). As a person encounters large amounts of unique information, uncertainty and anxiety result. Kuhlthau (1993) describes a "tolerance for uniqueness" at the beginning of the information search process until new constructs are built and redundancy occurs. This is consistent with Berlyne's (1960) description of

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"specific curiosity"---curiosity provoked by a lack of information about a complex, novel, and incongruous stimulus and leading to exploratory behavior designed to gather information in order to reduce uncertainty.

If curiosity and uncertainty are related, then a curious person would likely have a high tolerance for ambiguity. One who is intolerant of ambiguity perceives ambiguous materials or uncertain situations as unpleasant or threatening (Budner, 1962); while one who is tolerant of ambiguity may find the same materials or situations comfortable or even desirable and may actually seek out ambiguity and ambiguous situations that lack adequate structure of sufficient cues (MacDonald, 1970). Computer games that present an ambiguous but challenging task, therefore, may stimulate curiosity.

Malone (1981) considers the degree to which curiosity can be aroused and then satisfied as "one of the most important features of intrinsically motivating environments" (p. 337). He identified three additional factors (challenge, control, fantasy) that influence initial and continuing engagement in a task. These factors (except fantasy) are similar to the dimensions of flow, as described below.

Flow

Flow has been defined as "the process of optimal experience" (Csikszentmihalyi, 1975; Csikszentmihalyi & LeFevre, 1989) in which there is a satisfying, even exhilarating, feeling of creative accomplishment and heightened functioning. A flow state is one in which a person (1) suspends time and space while fully immersed in a challenging activity, (2) focuses attention on a limited stimulus field which provides clear and unambiguous feedback on actions taken, (3) perceives a sense of control, and (4) finds the experience, itself, rewarding (Csikszentmihalyi, 1975; 1990). Bialeschki & Henderson (1992) describe flow as an intersection of high skill level and high challenge. When the challenge is too high and the person's skill too low, anxiety is experienced; when the challenge is too low and the skill too high the person experiences boredom. A combination of low challenge and skill results in apathy.

People of all ages can experience flow in both work and leisure activities (Csikszentihmahlyi & LeFevre, 1989). Reiber (1996) asserts that "flow theory provides an important framework for an adult's motivation for learning" (p. 48). Research has shown that people will seek to replicate or find flow in the activities and events of their lives. Webster, Trevino and Ryan (1993) studied the playfulness of employees, using various application software in order to develop a measure of flow. They identified three dimensions of flow---control, focused attention, and enjoyment (combining curiosity and intrinsic interest). In addition, Csikszentihmahlyi (1990) found that providing clear requirements and immediate feedback also facilitated the flow experience.

Trevino and Webster (1992) recommend designing computer-mediated communication technologies that provide more user control, focus the user's attention, and incite curiosity and interest in order to increase positive attitudes and more positive changes in communication-related outcomes. Researchers (e.g. Carroll and Thomas, 1988; Davis, 1989) have articulated need for research on playfulness in various types of information systems.

Arnone and Small (1994) contend that there may be a parallel between Csikszentihmahlyi's concept of flow as optimal challenge and Berlyne's concept of curiosity as optimal level of arousal. However, the distinction between these two concepts is that curiosity requires some kind of conceptual conflict to be resolved while flow does not (Rotto 1994). Malone (1991) suggests that curiosity is aroused during the flow state. In computer-based environments, this can be accomplished through varied, novel and surprising stimuli such as color and sound and through providing options (e.g. menus) that encourage exploration (Trevino and Webster, 1992).

All of the factors used to describe a curious person or a person experiencing flow might also describe many users of computer games. "Simulations and games seem to embody many of the aspects of stimuli which theorists have found to increase motivation and maintain it at an optimal level" (Spitzer, 1976). All one needs to do is observe a game player in a video arcade or watch a Nintendo user to recognize intrinsically motivated behaviors (Rezabek, 1994), especially curiosity and flow. Many of these games' design elements (e.g. challenging problem to solve, goals with uncertain outcomes, immediate feedback, engaging task, interactive format) combined with user factors (e.g. intense concentration, a sense of control, the need to resolve cognitive conflict or incongruity) facilitate flow in this environment (Hoffman and Novak, 1995).

Cruickshank and Telfer (1980) list some specific advantages of simulations/ games as providing opportunities for (1) active participation, (2) problem-solving experiences, and (3) a responsive, engaging, safe, and enjoyable environment. Research that identifies some of the motivational elements of computer games and potential interventions that influence user motivation may be helpful for understanding how to design and organize information systems that stimulate the intense level of concentration, high curiosity level, perception of control, and enjoyment associated with the flow experience or that identify software that has "flow potential" (Bialeschki & Henderson, 1992, Mandler, 1984). These two pilot studies explored the relationships among motivation variables

and the impact of providing information to reduce uncertainty on subjects playing the highly-rated multimedia CD-ROM game, *Myst*.

Myst requires the individual user to explore a fantasy island and, through a series of visual puzzles, attempt to solve the island's mysteries. Named one of the best CD-ROMs of 1994 (Consumer Reports, 1995; Fortune, 1994; MacUser, 1994; New Media, 1994), *Myst* was chosen for this research because of its high motivation potential---beautiful and sophisticated 3-D graphics, mystical music and sound effects, and a challenging problem-solving format. Furthermore, it was especially appropriate for this research because of its high degree of ambiguity and its fantasy environment as players seek to identify and determine the dimensions of its problem situation. *Myst* appears to stimulate both types of curiosity described by Malone (1981)---sensory curiosity that is stimulated by an enriched learning environment (e.g. animation, music) and cognitive curiosity that is stimulated by an incomplete, inconsistent, unparsimonious environment.

Although highly engaging, *Myst* provides an ambiguous task for users through no verbal clues, uncertain goals, limited direction. It is what Bruner (1986) calls "an interpretive task," occurring when a person first encounters new information and requiring the person to recognize patterns in order to make inferences and predictions. Kuhlthau (1993) describes the information seeking process as one "in which users progress from uncertainty to understanding" (p. 345).

This paper reports the results of two small-scale, exploratory studies. Because the flow experience depends so heavily on focused attention on and control of a task, this research used a highly engaging task that provided (initially) no rules or goals to explore studies explored the effects of introducing an information intervention after subjects were fully engaged in the task on a range of motivational variables. The first study investigated the relationship of a users' tolerance for ambiguity, curiosity, and user beliefs and feelings, while second study focused on flow dimensions (attention focus, control, intrinsic interest, and curiosity).

Study I

The objective of Study I was to investigate the relationship of tolerance for ambiguity, trait and state curiosity and several feelings and beliefs of users while engaged in an ambiguous task (computer game). Research questions were:

(1) What is the relationship of motivation variables (tolerance for ambiguity, trait curiosity, state curiosity, user beliefs, user feelings) to user characteristics (age, gender)?

(2) What are the relationships among motivation variables?

(3) Does introduction of informational clues midway through a highly engaging, ambiguous task affect user motivation?

Subjects were 31 volunteer undergraduate students at a mid-size, northeastern university. There were 22 males and nine females, ranging in age from 19 to 32 with a mean age of 21. None of the subjects had ever played *Myst*. Instruments used were:

- Tolerance for Ambiguity Scale (AT-20) (MacDonald, 1970). This scale required marking twenty statements as either true or false. (Examples: "There's a right way and a wrong way to do almost everything." "Sometimes I rather enjoy going against the rules and doing things I'm not supposed to do.") The AT-20 Scale's split-half reliability was .86 and evidence for construct validity supported the hypothesis that high tolerance people tend to succeed in ambiguous tasks (MacDonald, 1970).
- Melbourne Curiosity Inventory (MCI). The two forms of this instrument were utilized in this study. The Trait Form (Naylor, 1981) measures a general capacity or propensity to experience curiosity (Loewenstein, 1994). It consists of twenty statements required ranking from 1 (almost never) to 4 (almost always). (Examples: "I think learning 'about things' is interesting and exciting." "I like to enquire about things I don't understand."). Naylor (1981) found this measure had high test-retest validity. The State Form (Naylor, 1981) measures curiosity toward a specific situation or event. It consists of twenty statements required ranking from 1 (not at all) to 4 (very much so). (Examples: "I feel curious about what is happening." "My interest has been captured."). Both forms are reported to have high reliability (e.g. Olson and Camp, 1984).
- User Dimension Scales (Small, 1995). This instrument contained two sub-scales. The User Beliefs sub-scale consisted of a nine-point Likert-type scale containing nineteen bipolar terms, derived from validated cognitive measures of flow developed by Trevino and Webster (1992) and Ghani, Supnick and Rooney (1991). These terms measured users' cognitive perceptions about the game (e.g. difficult-easy, consistent-inconsistent, familiar-unfamiliar) along a 7-point scale. The second sub-scale, User Feelings required subjects to rate their motivation on a

five-point scale ranging from 1 (not true) to 5 (very true). Ten items were considered positive terms (e.g. in control, excited, confident) and seven were negative (frustrated, confused, bored). Items were derived from the literature.

Procedures

Several days prior to the treatment, subjects were administered the Tolerance for Ambiguity Scale and the MCI-Trait Form. The treatment required subjects to spend up to one hour playing the multimedia CD-ROM game *Myst*. The treatment was conducted in a computer research lab environment. As subjects began the session, he/she was told that the directions for the game had been misplaced and he/she would have to try to figure out the game without any information.

After 30 minutes, subjects were told to stop playing the game and complete MCI---State Form and the User Dimension Scales. Before continuing the game, subjects were told that the game directions had been found and they were allowed to use them during the last half of the treatment. The directions, supplied by the game makers, consisted of three brief hints. At the end of the hour, subjects were again administered the MCI-State Form and the User Dimension Scales.

Results: Study I

Data were analyzed according to each of the research questions.

(1) What is the relationship of motivation variables to user characteristics (age, gender)?

Results reported in Table 1 show that in this study, age had a negative relationship ($p<.05$) with both (post) trait and state curiosity; i.e. the older the subject, the less curious he/she was. Age had a positive relationship with (post) user feelings; i.e. user's feelings toward the task increased with age.

	Tolerance for Ambiguity	Trait Curiosity	State Curiosity (mid)	State Curiosity (post)	User Beliefs (mid)	User Beliefs (post)	User Feelings (mid)	User Feelings (post)
Age	-.09 (29)	-.33* (29)	-.37* (29)	-.32* (28)	.01 (28)	.18 (27)	-.001 (28)	.32* (28)

* =p<.05; ** =p<.01; *** =p<.001; ****p<.0001 ¹= p<.10.

Table 1. Correlation Coefficients for Motivation Variables by Age.

The only gender difference occurred on the (post) state curiosity dimension where females had significantly higher scores ($p<.05$) than males (see Table 2). All motivation scores showed a slight decrease from mid to post measures for both males and females.

	Male		Female		df	t
	M	sd	M	sd		
Age	21.55	3.11	20.44	.73	29	1.04
Tolerance for ambiguity	8.50	3.05	9.00	3.71	29	-.39
Trait curiosity	3.42	.35	3.19	.38	29	1.55
State curiosity (mid)	3.40	.51	3.56	.25	29	-.87
State curiosity (post)	3.16	.61	3.51	.30	27.21	-2.08*
User Beliefs (mid)	4.24	.76	4.19	.83	28	.16
User Beliefs (post)	4.07	.90	4.18	.64	27	-.33
User Feelings (mid)	3.30	.56	3.24	.64	29	.30
User Feelings (post)	3.04	.67	2.97	.41	28	.29

* =p<.05; ** =p<.01; *** =p<.001; ****p<.0001 ¹= p<.10.

Table 2. Independent T-Test for Motivation Variables by Gender.

(2) What are the relationships among motivation variables?

Table 3 reveals a negative relationship ($p<.05$) between tolerance for ambiguity and (both mid and post) state curiosity. There was also a negative relationship ($p<.05$) between tolerance for ambiguity and both (mid) user dimensions ($p<.05$) and post) user dimensions ($p<.01$). Thus it appears that in this study, the higher the level of tolerance for ambiguity, the lower the level of state curiosity and post user dimensions . Additionally, mid and post

state curiosity were significantly related (p<.001) and so were mid and post user beliefs (p<.05), while the correlation between mid and post user feelings approached significance (p=.09). State curiosity (mid) was also significantly correlated with both user beliefs (mid) and user feelings (mid) (p<.05). State curiosity (post) was related to both user beliefs (post) (p<.01) and user feelings (post) (p<.05). User beliefs (mid) were significantly correlated with user feelings (mid) (p<.001) and user beliefs (post) were related to user feelings (post) (p<.001).

	Tolerance for Ambiguity	Trait Curiosity	State Curiosity (mid)	State Curiosity (post)	User Beliefs (mid)	User Beliefs (post)	User Feelings (mid)	User Feelings (post)
Tolerance for Ambiguity	*******							
Trait Curiosity	.01 (27)	*******						
State Curiosity (mid)	-.34* (29)	-.19 (29)	*******					
State Curiosity (post)	-.31* (28)	.01 (28)	.70*** (28)	*******				
User Beliefs (mid)	-.20 (28)	-.18 (28)	.48** (28)	.25' (27)	*******			
User Beliefs (post)	-.30* (27)	.12 (27)	.11 (27)	.45** (27)	.39* (26)	*******		
User Feelings (mid)	.09 (29)	-.18 (29)	.30* (29)	.17 (28)	.72*** (28)	.10 (27)	*******	
User Feelings (post)	-.42** (28)	.21 (28)	.06 (28)	.36* (28)	.28' (28)	.71*** (27)	.25' (37)	******* *

* =p<.05; ** =p<.01; *** =p<.001; ****p<.0001 '= p<.10.

Table 3. Correlation Coefficients for Motivation Variables.

(3) Does introduction of informational clues midway through a highly engaging, ambiguous task affect user motivation?

(Post) state curiosity scores showed a significant decrease from (mid) state curiosity scores after receiving an information help sheet (p<.05) (see Table 4). Differences in user dimensions were not significantly different; however, a mid-to-post decrease in scores was noted, with the decrease in user feelings approaching significance (p=.06).

Variable	M	s	df	t
State Curiosity (mid)	3.43	.45	29	2.24*
State Curiosity (post)	3.27	.56		
User Beliefs (mid)	4.20	.76	27	.82
User Beliefs (post)	4.07	.81		
User Feelings (mid)	3.27	.58	29	1.92'
User Feelings (post)	3.02	.60		

* =p<.05; ** =p<.01; *** =p<.001; ****p<.0001 '= p<.10.

Table 4. Correlated T-Test for Mid and Post Motivation Variables.

Discussion

This study sought to determine relationships among various motivation variables and user characteristics and the effects of receiving information while engaged in an ambiguous task. Subjects playing the CD-ROM game, *Myst* were provided with an information help sheet at the mid-point in the treatment. One result, a negative correlation between tolerance for ambiguity and both mid and post state curiosity is contrary to findings by Boykin

and Harackiewicz (1981) and appears to contradict the very nature of curiosity; i.e. that it is stimulated by incongruity and uncertainty in the environment.

The negative correlation between age and both trait and state curiosity is consistent with past research. Day (1982) describes a decline of curiosity with age when there is more emphasis on specificity and extrinsic rewards during formal education. The resulting significantly higher state curiosity for females than males after playing the game was an interesting finding, particularly given the small number of female subjects in this study.

Both state curiosity measures were highly related to each of the user dimensions. A person's curiosity level may affect both their positive beliefs about their abilities for achieving the game's challenge and their desire to do so. In addition, the informational clues appear to have had some affect on final curiosity levels, as state curiosity scores decreased significantly after receiving them. Yovits and Foulk (1985) found that information may increase rather than decrease uncertainty in some situations.

Study II

The purpose of Study II was to explore how the introduction of information affects subjects were engaged in an ambiguous task affected their motivation. In this study, motivation variables comprised the dimensions of flow---attention focus, control, intrinsic interest, curiosity, Research questions were:

(1) Is there a relationship between motivation variables (attention focus, control, intrinsic interest, curiosity, total flow) and specific user characteristics (age, gender)?

(2) Does the introduction of an informational help sheet midway through a highly engaging but ambiguous task affect subjects' motivation?

(3) Are there differences between treatment groups on mid and post motivation scores?

(4) Is there a relationship between level of excitement, challenge, and frustration and each of the motivation variables?

(5) Does level of motivation affect the desire to engage in the same task again?

Subjects were 29 volunteer undergraduate students (22 males; 7 females) at a mid-sized, northeastern university. None had ever played *Myst*. Subjects were randomly assigned to one of two treatment groups---one that received an informational help sheet midway through the session and one that did not.

Subjects were asked to spend two hours in a computer research lab playing the multimedia CD-ROM game *Myst*. As they began the session, they were told that the directions for the game had been misplaced and they would have to try to solve the mystery of the game without them.

After 45 minutes, subjects were told to stop playing the game and complete a nine-point Likert-type scale that required them to rate their feelings at that point in time on 23 opposite terms (e.g. focused-unfocused; free-constrained; excited-bored; curious-disinterested). Terms included the 13 items from Csiksentmihalyi and Larson's (1987) Experience-Sampling Form and ten additional items derived from the literature (e.g. Ghani, Supnick and Rooney, (1991). Personal data (age, gender) were also collected.

Before resuming the game, one treatment group was given a one-page paper containing specially-developed information for solving some of the game's most difficult elements, while the other treatment group was given no additional information. After 45 minutes, subjects were again administered the same Likert-type scale and were also asked to rate their level of excitement, challenge, and frustration with playing this game. Subjects receiving the information were also asked four questions about the helpfulness of the information provided.

Results: Study II

Data were analyzed according to each of the research questions.

(1) Is there a relationship between motivation variables (attention focus, control, intrinsic interest, curiosity, total flow) and specific user characteristics (age, gender)?

Variable	Men		Women		df	t
	M	s	M	s		
Attention Focus (mid)	5.80	2.13	4.83	1.15	27	1.14
Attention Focus (post)	5.30	2.36	4.74	1.12	27	.60
Control (mid)	4.38	1.79	4.18	.44	26.42	.48
Control (post)	4.49	2.02	4.10	1.17	18.07	.62

Intrinsic Interest (mid)	4.47	1.55	3.31	1.12	27	1.83[1]
Intrinsic Interest (post)	4.82	1.77	3.73	1.30	27	1.50
Curiosity (mid)	5.52	1.87	4.39	.73	27	1.54
Curiosity (post	5.62	1.50	4.82	1.29	27	1.27
Total Flow (mid)	5.04	1.63	4.18	.50	26.99	2.19*
Total Flow (post)	5.06	1.76	4.35	1.09	27	1.00

* =p<.05; **=p<.01; ***=p<.001; ****=p<.0001; [1] =p<.10.

Table 5. Independent T-Test for Flow Variables on Gender.

In (both mid and post) treatment scores, there appear to be no significant relationships between any of the motivation variables and age. However, as indicated in Table 5, males scored significantly higher on (mid) total flow measures than females (p<.05) and approached significance on (mid) intrinsic interest (p=.08).

(2) Does the introduction of an informational help sheet midway through a highly engaging but ambiguous task affect subjects' motivation?

It is worthwhile to compare post-treatment scores only when comparing means between subjects who received information and those who did not, since the information was provided immediately following administration of the mid-treatment instruments. Results, reported in Table 6, indicate that subjects who received the informational help sheet had higher curiosity (p<.05) and feelings of control (approaching significance at p= .08) and total flow (approaching significance at p=.09). A subsequent t-test comparing mid to post-scores on all motivation variables showed no significant differences.

Variable	With Hints		Without Hints		df	t
	M	s	M	s		
Attention Focus	5.71	2.23	4.59	1.91	27	1.45
Control	5.10	1.79	3.98	1.48	27	1.84[1]
Intrinsic Interest	4.81	1.93	3.95	1.69	27	1.27
Curiosity	5.95	1.32	4.87	1.46	27	2.08*
Total Flow	5.39	1.63	4.35	1.51	27	1.78

* =p<.05; **=p<.01; ***=p<.001; ****=p<.0001; [1] =p<.10.

Table 6. Group/Independent T-Test of Flow Variables for Both Treatment Groups.

(3) Are there differences between treatment groups on mid and post motivation scores?

Results indicate no significant differences from mid to post treatment scores for subjects in either treatment group on all motivation variables (see Table 7). Thus, it can be concluded that in this study, the introduction of information at mid-point in the treatment did not affect motivation level.

	Total				With Hints				Without Hints			
Variable	M	s	df	t	M	s	df	t	M	s	df	t
Attention Focus (mid)	5.57	1.97	28	1.29	5.93	2.20	14	.58	5.17	1.69	13	1.17
Attention Focus (post)	5.17	2.13			5.71	2.23			4.59	1.91		
Control (mid)	4.19	1.52	28	-1.69	4.52	1.81	14	-1.87	3.83	1.10	13	-.48
Control (post)	4.56	1.71			5.10	1.79			3.98	1.48		
Intrinsic Interest (mid)	4.33	1.57	28	-.29	4.49	1.85	14	-1.04	4.16	1.23	13	.78
Intrinsic Interest (post)	4.39	1.84			4.81	1.93			3.95	1.69		
Curiosity (mid)	5.25	1.73	28	-.75	5.85	2.03	14	-.27	4.61	1.06	13	-.86
Curiosity (post)	5.43	1.47			5.95	1.32			4.87	1.46		

Total Flow (mid)	4.83	1.48	28	-.25	5.20	1.79	14	-.68	4.44	.96	13	.29
Total Flow (post)	4.89	1.64			5.39	1.63			4.35	1.51		

* =p<.05; **=p<.01; ***=p<.001; ****=p<.0001; ' =p<.10.

Table 7. Correlated T-Test for Mid and Post Scores on Flow Variables for Both Treatment Groups.

(4) Is there a relationship between level of excitement, challenge, and frustration and each of the motivation variables?

Each of the motivation variables was highly positively correlated with level of excitement (see Table 8). Challenge, however, although significantly correlated with curiosity (p<.05), had no relationship to the other motivation variables. Frustration, on the other hand, was significantly negatively correlated

	Attention	Control	Intrinsic Interest	Curiosity	Total Flow
Excitement	.65**** (26)	.50** (26)	.71**** (26)	.66**** (26)	.69**** (26)
Challenge	.17 (26)	-.10 (26)	.13 (26)	.36* (26)	.15 (26)
Frustration	-.33* (26)	-.45** (26)	-.50** (26)	-.35* (26)	-.45** (26)

* =p<.05; **=p<.01; ***=p<.001; ****=p<.0001; ' =p<.10.

Table 8. Correlation Coefficients for Excitement, Challenge, and Frustration on Flow Variables for All Subjects.

with all motivation variables. Thus, the more frustrated subjects felt afterplaying the game, the lower their scores on all motivation variables. Additional analyses were conducted to determine whether there were differences between treatment groups on excitement, challenge, and frustration levels and no significant differences were found.

(5) Does level of motivation affect the desire to engage in the same task again?

Subjects were asked "Would you play this game again on your own?" An independent t-test of motivation variables and desire to play the game again revealed significantly higher intrinsic interest (p<.001), curiosity and total flow (p<.05) for subjects who said they wanted to play the game again (see Table 9). Differences in attention focus scores approached significance (p=.07).

Variable	Want to Play Again		Don't Want to Play Again		df	t
	M	s	M	s		
Attention Focus	5.49	2.21	3.73	1.18	26	1.86'
Control	4.71	1.77	3.86	1.53	26	1.07
Intrinsic Interest	4.83	1.80	2.59	.56	25.09	4.99****
Curiosity	5.77	1.34	4.08	1.37	26	2.73*
Total Flow	5.20	1.66	3.57	.84	26	2.31*

* =p<.05; **=p<.01; ***=p<.001; ****=p<.0001; ' =p<.10.

Table 9 Independent T-Test of Several Variables on the Desire to Play Again

Subjects in the information treatment group were asked three questions about the relative usefulness of the informational help sheet for solving the game's problem, for moving through the game, and for understanding the game's structure and one question as to whether they liked receiving the information. Of the 14 subjects receiving information, 11 (78%) indicated they appreciated receiving them, stating they gave them direction, options, and alternatives to try. "The hints only provide a little direction instead of the user being lost totally" one subject wrote. Another subject indicated that after receiving the information, he advanced a little more but not enough to be satisfied. Another wrote, "(I)t would take long to figure it out on my own, however, I was still having problems after receiving the (information)." Of the three subjects reponding negatively about receiving information, two said they had already figured it out by themselves and one said it didn't provide enough information. Thus, in general, it

appears that the information did not afford much help for solving the problem, and therefore, did not affect subjects' motivation.

Discussion

This study indicates that the introduction of information to subjects at mid-point in an engaging but ambiguous task had little effect on their overall flow. In an evaluation of six studies on the effectiveness of instructional simulation games, Cherryholmes (1966) posited that lack of effects may have been due to presenting subjects with the simulation rules and that the effectiveness of simulation games may come from students discovering those rules. Reiser and Gerlach (1977) further state that it is the structure, rather than the content, of simulation games and its mastery that causes high student interest. Subjects in this study appear to have found the information helpful in understanding the game's structure.

Conclusions and Recommendations

There may be other explanations for the lack of effects of receiving relevant information while playing the game *Myst*. One is the small number of subjects in these studies, which made it difficult to identify real differences among groups, hence the use of t-tests rather than analysis of variance. Another is the challenge of playing this particular game may have been too high so that users' skills did not match the level of challenge (a requirement of flow), possibly causing high levels of frustration as, indicated in the results, and the quality of amount information may not have been sufficient to lower these levels.

These two exploratory pilot studies attempted to determine the effects of introducing an informational intervention on undergraduate students' motivation while playing a highly engaging computer simulation game. The first study looked at relationships among tolerance for ambiguity, trait and state curiosity, and user beliefs and feelings and whether receiving information affected those motivation variables. The second study studied the effects of receiving information on several flow variables. The treatment differed from the first study in that it increased the amount of time allowed for subjects to be engaged in playing *Myst* and provided richer information to subjects in the information treatment group.

Researchers have found positive correlations between flow and experimentation and exploratory behavior (e.g. Webster, Trevino, and Ryan, 1993) and the playfulness of flow in human-computer interactions has highly correlated with higher experimentation (e.g. Ghani, Supnick and Rooney, 1991). Research has also found that activities labeled as "play" rather than "work" positively influence intrinsic motivation and productivity (e.g Sandelands, 1988; Webster et al. 1990). Interfaces that incorporate motivation elements that enhance the playfulness of information systems may lead to greater exploratory and information seeking behaviors in users.

Flow is largely perceived as positive for encouraging persistence at a task. However, Rafaeli (1985) and Jarvenpaa and Dickson (1988) argue that flow has a cost in terms of time and attention to a work task. People may be so engaged that too much time is spent on the task. Although these studies were conducted in "playful" situations, it would be worthwhile to implement similar research studies in work environments. In Study I, it appeared that interrupting a playful activity with information that could encourage more speedy resolution of the task may negatively influence motivation. However, in Study II, the information intervention had a somewhat positive effect on users' perceptions of control and did not appear to negatively influence flow..

Trevino and Webster (1992) recommend research to determine the relative effects of flow on productivity. It might also be useful to continue to study the effects of information interventions introduced at different points in the experience (beginning, middle) on mediating motivational factors such as curiosity and flow while learning a new software package or other engaging work task.Providing subjects with a choice of when to use an information intervention might also provide insights into when and how such interventions are useful.

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